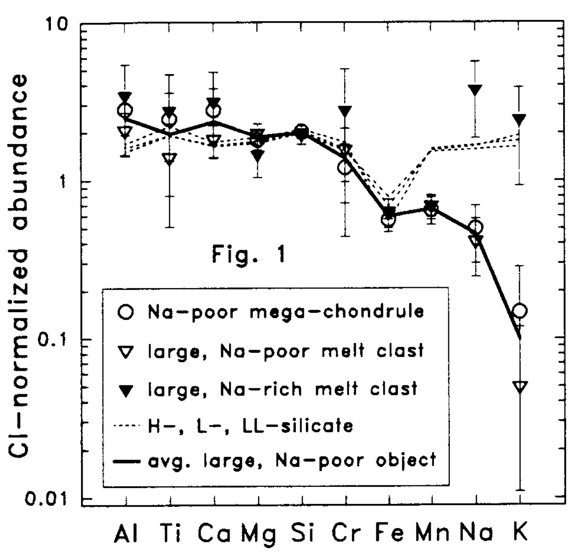
LARGE CHONDRULES AND LITHIC CLASTS IN JULESBERG (L3) AND OTHER ORDINARY CHONDRITES: BULK-CHEMICAL CHARACTERIZATION. Alex Ruzicka, Gregory A. Snyder, and Lawrence A. Taylor. Planetary Geosciences Institute, Dept. Geological Sciences, University of Tennessee, Knoxville, TN, 37996.

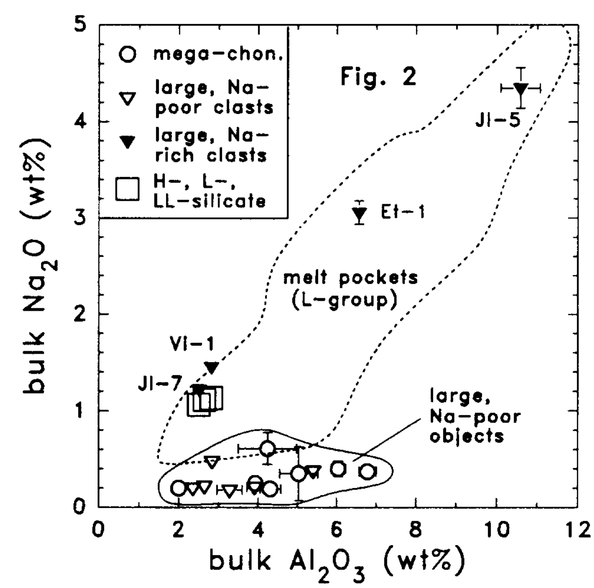
Igneous-textured objects much larger than typical chondrules have been described in many ordinary chondrites [e.g., 1-4]. These objects may be: (a) large variants of normal-sized chondrules, known as mega-chondrules (macro-chondrules of [1]), (b) impacts melts of chondritic material [2], or (c) igneous differentiates [3, 4]. We have performed a systematic petrographic-chemical study of large "melt" objects, focussing on one weakly-metamorphosed chondrite (Julesberg, L3). As discussed in a companion abstract [5], the large melt objects we have studied can be subdivided into two groups based on shapes, textures, and phase compositions, including (1) large, Na-poor lithic clasts and mega-chondrules, and (2) large, Na-rich clasts. In this abstract, we describe the bulk compositions of objects in these two groups. We conclude that the objects in these two groups formed by fundamentally different processes. The same two groups appear to be present in normal-sized chondrules and clasts in ordinary chondrites.

NA-POOR MEGA-CHONDRULES AND LITHIC CLASTS-- These objects have overlapping major-element bulk compositions (Fig. 1), suggesting that they formed by similar processes or were derived from materials of similar composition. The CI-normalized abundances of mega-chondrules and Na-poor clasts are highest for refractory elements such as Al and Ca, and lowest for volatile elements such as Na and K (heavy line in Fig. 1; CI data from [6]). Compared to ordinary chondrite silicate, these objects are enriched in refractory elements such as Al and Ca and progressively depleted in the volatile elements Fe, Mn, Na, and K (chondrite data from [7]). As a group, the objects also show chemical trends that are consistent with a volatility-dependent fractionation process. These chemical trends include a positive correlation between Mg/(Mg+Fe) and Al, a relatively uniform Ca/Al ratio, and positive correlations between Si/Al and the ratios Mg/Al, Fe/Al, and Na/Al. Thus, it appears that *the compositions of Na-poor clasts and mega-chondrules were established largely by vapor-fractionation.*

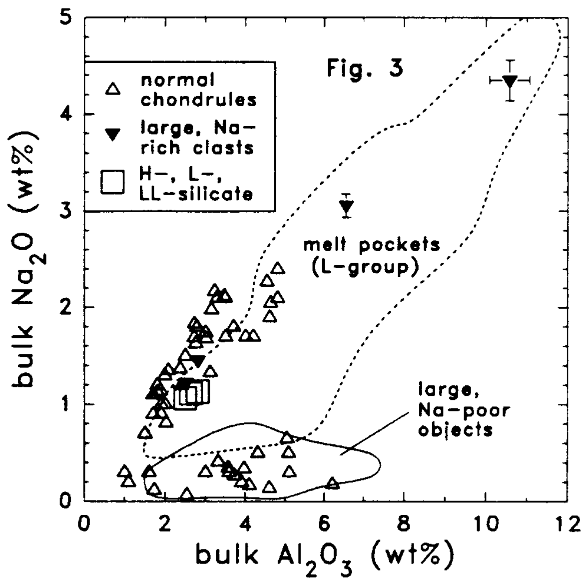
NA-RICH CLASTS-- Unlike Na-poor clasts and mega-chondrules, Na-rich clasts show no evidence for volatility-related fractionations. For example, in Na-rich clasts, the highly volatile element Na is correlated with the refractory element Al (Fig. 2). Compared to ordinary chondrite silicate, these objects are enriched in incompatible elements (Al, Ti, Ca, Na, K) and depleted in more compatible elements (Mg, Fe, Mn) (Fig. 1). As a group, Na-rich clasts show chemical trends that overlap or parallel those of melt-pocket glasses (Fig. 2; melt-pocket data of [8-9]). This suggests that *Na-rich clasts formed by a process similar to that which formed melt pockets, namely, the incipient-to-complete melting of chondrites* [8, 9]. The two large, Na-rich clasts, Jl-7 and Vi-1, have compositions generally similar to that of ordinary chondrites (Fig. 2). These clasts could have formed by *nearly complete* melting of chondritic material. In support of this possibility is the texture of Jl-7, which is best explained as a clast-laden impact- melt [5]. Compared to ordinary chondrite silicate, the large, Na-rich clasts, Et-1 and Jl-5, are enriched in a feldspar component and depleted in an olivine component, and have high Na and Al contents (Fig. 2). The bulk compositions of these objects may have formed by the *incipient* shock-melting of chondritic material, with the incipient melt enriched in feldspar and depleted in olivine.

COMPARISON TO NORMAL-SIZED CHONDRULES-- The two groups described above appear to have counterparts among much smaller chondrules. The bulk compositions of normal-sized, ferromagnesian chondrules appear to form two groups on an Al-Na diagram (Fig. 3; chondrule data from [10-14]). One group has a Na/Al ratio





much lower than chondritic, similar to Na-poor clasts and mega-chondrules, while the other group has a Na/Al ratio similar to chondrites and Na-rich clasts (Fig. 3). This suggests that there are two distinct populations of normal, ferromagnesian chondrules, and they may have formed in similar ways to the larger melt objects. Some evidence for different populations among normal-sized chondrules was noted by Dodd [10, 11]. Many Na-Al-rich chondrules have roughly chondritic Na/Al ratios, but are enriched in Na and Al compared to melt-pocket glasses. Such objects may also have formed by the incipient impact-melting of chondritic material [15]. Thus, *the same processes that formed large lithic clasts and mega-chondrules were operative in the formation of normal-sized chondrules.*



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